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Abstract: Globally, the largest 0.001 per cent of firms earn roughly one-third of all corporate profits. Nonetheless, there is little understanding of how profit shifting differs across firm size. Using South African corporate tax returns from 2010–14, we investigate the link between firm size and profit shifting. We estimate that firms owned by a parent in a tax haven avoid taxation on as much as 80 per cent of their true income. However, this aggregate tax loss conceals large differences across firms. The majority of firms shift little income to tax havens, while a few large firms shift a lot. The top decile of foreign-owned firms accounts for 98 per cent of the total estimated tax loss. This extreme concentration of tax planning has not been documented before and has implications for both research and policy. First, our results imply that tax havens create competitive distortions as larger firms benefit more. Second, as past research does not account for heterogeneity across firms, it may underestimate the total tax loss caused by profit shifting. As an illustration of this, we revisit the OECD's official estimate of profit shifting and find that profit shifting may have been dramatically underestimated.

Keywords: tax, international taxation, profit shifting, multinational firms, developing countries
JEL classification: H25, H26, H87, O23

Full regression results, data, and auxiliary findings can be found in the online appendix accessible here (https://www.wider.unu.edu/publication/big-and-unprofitable).

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The views expressed in this article are those of the authors and do not necessarily reflect those of the National Treasury of South Africa nor UNU-WIDER.

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1 Introduction

The multinational enterprise (MNE) is on the rise; in the last 30 years the share of global corporate profits accruing to non-residents has more than tripled (Tørsløv et al. 2018). This development has opened up a new avenue of tax avoidance where firms artificially move taxable profits to tax havens (commonly referred to as 'profit shifting'). High-profile 'leaks' have documented how this type of tax planning is eroding the tax payments of some of the world's largest companies.[1] Across the world, governments, international institutions, and the general population express concern about the sustainability of corporate tax.[2]

Firms come in very different sizes. Globally, the largest 0.001 per cent of firms earn roughly one-third of all corporate profits.[3] Hence, understanding the behaviour of the largest firms is key if one seeks to examine the overall scale of profit shifting. In the public and political debate it is often assumed that the firms shifting the most profits are also the largest.[4] Nonetheless, there is little systematic evidence of how profit shifting differs across firm size. In this paper, we investigate the link between firm size and profit shifting. We find that the bulk of profit shifting occurs at the very top, while the majority of firms shift little or no profits. As the largest firms have the most profits to shift, failing to account for increased profit shifting at the top will lead to dramatically underestimated tax losses.

Inequality in profit shifting across firms has important implications for both policy and research. First, whereas previous research has focused on tax losses, this paper highlights another potential welfare implication of profit shifting. A concentrated tax benefit given to a few large firms distorts competition and as a result may create an efficiency loss.[5] Second, as we show in this paper, failing to account for heterogeneities in profit shifting across firms will severely underestimate the tax loss caused by profit shifting. That is, when aggregating the profits shifted by firms, one must take into account that the firms with the largest profits shift the most profits. This insight is not only relevant when estimating overall tax losses, but essential when evaluating policies that aim to limit profit shifting. As the bulk of profit shifting occurs at the top of the size distribution, anti-shifting policies should mainly be evaluated at the top as well. Finally, from an ethical perspective, it may simply seem less 'fair' that few firms obtain the tax benefits of tax havens while most do not.

As important as profit shifting may be in developed countries, the current hypothesis is that the issue is even more relevant in developing countries. This is because of the dire outcome of any additional tax loss in countries that are already severely financially constrained. Additionally, capacity-constrained tax authorities in these countries will be underequipped to deal with complex

[1] Most recently, the Paradise Papers revealed the tax planning strategies of Apple, Google, Nike, and Facebook. Outside of the Western hemisphere, Glencore, SAB Miller, and Barclays are the companies that have caused public outcry in Africa.

[2] See e.g. UNCTAD (2015), IMF (2016), and OECD (2015c).

[3] From a simple back-of-an-envelope calculation: Forbes report that the largest 2,000 companies earned US$3.3 trillion in 2015. In the same year, Tørsløv et al. (2018) estimate global profits were US$11.5 trillion. Finally, ORBIS have managed to identify 200 million companies globally.

[4] See for example Jones (2015b) or Boffey (2017).

[5] In fact, the argument of unfair competition is what drives recent legal procedures in the EU involving Apple, Starbucks, Fiat, and IKEA (Boffey 2017). Johannesen (2012) shows theoretically how these distortions lead to the existence of firms that, from a welfare perspective, should have been crowded out.

multinational tax planning.[6] However, lack of credible empirical evidence has led to stern debate on the actual size of the issue in developing countries (Forstater 2015; Johannesen and Pirttilä 2016). In this paper, we gain access to the universe of South African corporate tax returns, which enable us to observe foreign-owned firms operating in South Africa. While using tax-administrative data to estimate profit shifting is best practice, only Germany, Norway, Sweden, and the United States have granted researchers access to tax return information on MNEs.[7] Profit-shifting estimates outside of these countries rely on macro data or proprietary micro datasets with issues of sample selection and missing information on tax credits (OECD 2015a; Tørsløv et al. 2018). This is the first study to exploit a tax administrative dataset to estimate profit shifting in a developing-country setting.

To estimate profit shifting we employ the standard approach by relating economic activity (such as wage bill and assets) to taxable profits (from which taxes are paid). If a firm reports low taxable profits while economic activity is high, this is a first indication of profit shifting.[8] Low profitability could also be the result of poor management or types of tax avoidance other than profit shifting. However, if firms with an affiliation to tax havens have systematically lower profitability relative to firms with no haven relation (within the same industry and with similar production inputs), this is taken as indirect evidence of profit shifting. Previous micro studies estimate profit shifting by estimating this profitability gap in an unweighted regression analysis.[9] This procedure yields an estimate of average profit shifting across firms but puts equal weight on firms with large and small profits. However, since the key policy parameter is not *average* but *total* profit shifting, it is important to weigh the profit shifting of each firm by its taxable profits.

Not accounting for size implies that profit shifting gets underestimated. The reason is that larger firms shift more *and* have higher taxable profits to shift. To show this, we begin by following prior research and estimate the unweighted average effect of a tax haven affiliation. In the South African case, we find that, conditional on production inputs and within industry, the *average* firm with a parent in a tax haven reports 34 per cent less taxable income than the *average* foreign-owned firm with no parent in a tax haven. Following the above-mentioned logic, the immediate conclusion is that 34 per cent of tax payments from these firms are lost. However, this analysis hides the fact that for the smallest 50 per cent of firms there is no estimated tax loss, that is, no response to a tax haven connection. On the contrary, the estimated tax loss resulting from a tax haven connection is 78 per cent in the largest 10 per cent of firms (see Figure 1a). As the largest 10 per cent of firms account for the bulk of the tax base, we show that the *total* tax loss is underestimated by more than 80 per cent when not accounting for these differences across firm size. The combination of high profits and more aggressive profit shifting implies that the largest 10 per cent of foreign-owned firms account for 98 per cent of all profits shifted to tax havens (see Figure 1b). Inequalities in profit shifting transcend South Africa. In the micro database that is most used for profit shifting studies (ORBIS), the largest 2 per cent of firms (measured according to wage bill)

[6] As noted by the OECD in their G20-mandated report on base erosion and profit shifting: 'developing countries face difficulties in building the capacity needed to implement highly complex rules and to challenge well-advised and experienced MNEs' (OECD 2014).

[7] OECD (2015a: 32–37) discuss the lack of tax return usage and identify the databases in the United States, Germany, and Sweden. In addition, a recent working paper by Hopland et al. (2018) gains (partial) access to Norwegian MNE tax returns.

[8] The seminal work by Grubert and Mutti (1991) and Hines and Rice (1994) introduced this methodology using macro data and it has since become its own strand of research. Heckemeyer and Overesch (2013) and Dharmapala (2014) give an overview of the later literature, which predominantly relies on micro studies. See also de Mooij and Ederveen (2008).

[9] The unweighted regression analysis (which allows all firms to have the same weight) is applied in all of the plus-thirty micro studies referenced in Heckemeyer and Overesch (2013) and Dharmapala (2014). To our knowledge, no micro studies of profit shifting at the firm level have used a weighted regression analysis.

earn 45 per cent of all profits. We revisit OECD's official Base Erosion and Profit Shifting (BEPS) estimate (Johansson et al. 2017), which exploits the ORBIS micro database in an unweighted regression analysis and find that profit shifting might be underestimated by as much as 40 per cent. The empirical concerns of not accounting for size stretch further than the dollar amounts lost. ORBIS only covers 17 per cent of all subsidiaries (Tørsløv et al. 2018)—if the composition of the subsidiaries not covered is related to firm size, this will have implications for the micro results.[10]

These findings can help to explain the notable gap between micro and macro estimates of profit shifting. The most cited recent micro studies estimate average tax losses of less than 2 per cent of corporate tax revenues (Huizinga and Laeven 2008; Dharmapala and Riedel 2013) and no more than 4 per cent (Johansson et al. 2017).[11] On the contrary, macro studies find tax losses of 8–25 per cent of corporate tax revenues.[12] This has led to the puzzle of a micro/macro gap in profit-shifting estimates (see e.g. Beer et al. 2018). There is of course a clear way to reconcile these differing conclusions: a few very large firms avoid a lot of taxes, while a lot of small firms do not avoid taxes at all. To examine this further, we add up the South African tax returns of foreign-owned subsidiaries to replicate past macro findings. Consistent with past macro estimates, we find that that profitability is 80 per cent lower in firms with a tax haven affiliation. Using the micro data, we can then calculate the contribution of each firm to the macro estimate of artificially shifted profits. Remarkably, we find that the macro estimate is driven by very few firms—10 firms drive 50 per cent of the aggregate profitability gap.

[10] Concerns about coverage and other shortcomings of the ORBIS database are well explained in the OECD (2015a) report that estimated the global revenue loss arising from BEPS. According to the OECD (2015a), the ORBIS database 'is based upon financial account rather than tax return data. With respect to its representativeness for the purposes of BEPS empirical analysis, Cobham and Loretz (2014) note the Eurocentric nature of the sample and its weakness in coverage of low-income'. See OECD (2015a: chapter 1) for a discussion.

[11] Beer et al. (2018) do a meta study using past micro evidence and reach a 'consensus' estimate of a tax loss of 2.7 per cent of corporate tax receipts.

[12] See Clausing (2016), Crivelli et al. (2015), Hines and Rice (1994), Tørsløv et al. (2018), UNCTAD (2015), and Zucman (2014).

Figure 1: Profit shifting across firm size

Figure 1a: Impact of tax haven affiliation on profitability

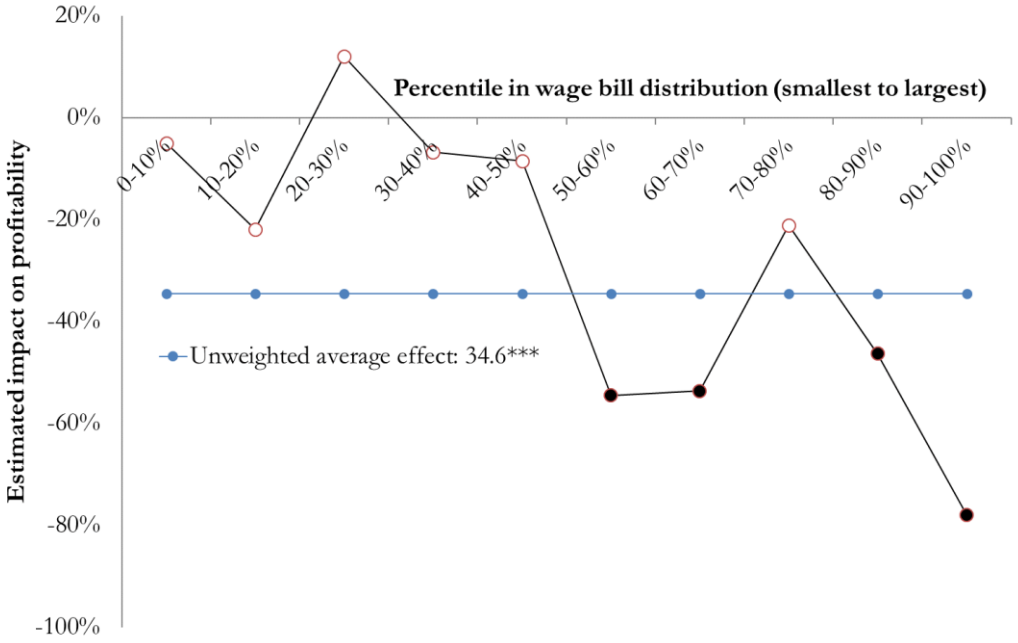
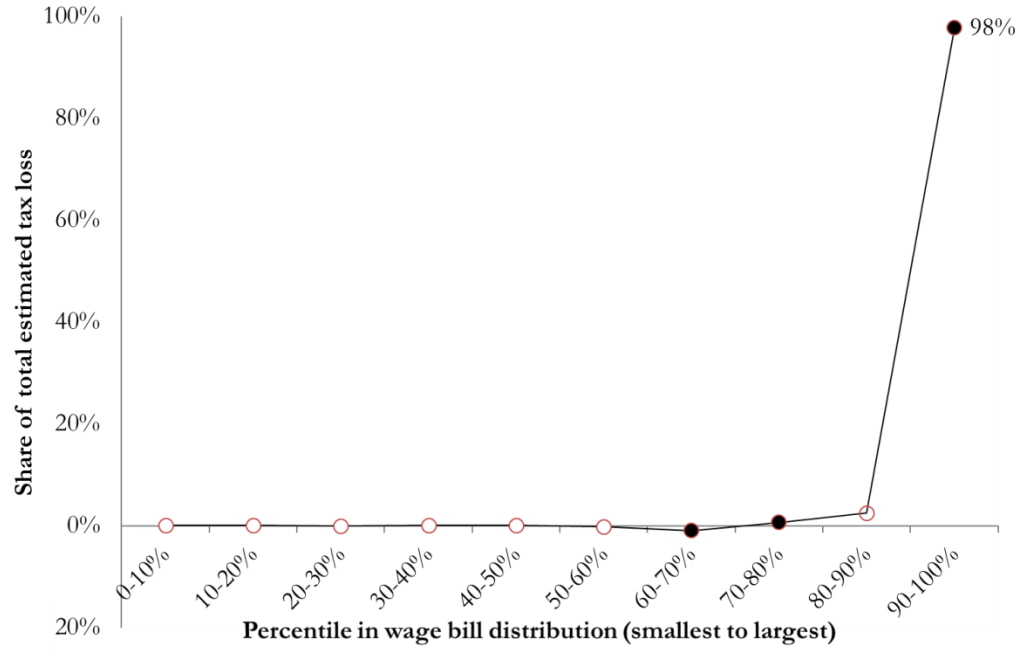


Figure 1b: Share of total estimated tax loss



Note: Figure 1a shows the differential impact of having a parent in a tax haven. Size deciles are constructed using wage bill; 0–10% being the smallest 10% of firms and 90–100% being the largest 10%. The OLS model $\log(\pi_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \text{Parent in haven}_i + \alpha_{nt} + \epsilon_i$ is estimated within deciles and β_3 plotted. An empty marker indicates statistical insignificance. The blue line shows the unweighted average estimate of β_3. Figure 1b uses the coefficients from Figure 1a to estimate the tax loss of each decile and then reports each decile's share of the total estimated tax loss.

Source: Authors' calculations based on data from SARS (n.d.).

To summarize, this paper contributes to the literature in two unique ways. First, it documents inequalities in the tax planning of multinationals and the importance of these inequalities for our understanding of profit shifting. Second, it is the first study to exploit actual tax returns in a developing country to examine the issue of international tax planning.

The paper will continue as follows: in Section 2, we briefly explain the South African context. In Section 3, we elaborate on the tax administrative data source used in this paper. In Section 4, we briefly motivate why size may be a factor when firms decide how much profit to shift. In Section 5, we present a simple visual analysis of the striking patterns in taxable income across firms. In Section 6, we move to a simple profitability analysis that allows us to look at firm-level contributions to past macro estimates of profit shifting, before turning to a regression analysis of the heterogeneity of profit shifting across firm size in Section 7. Finally, we show how the OECD BEPS estimate changes when accounting for firm size and discuss the overall findings of the paper in Sections 8 and 9.

2 South African context

South Africa is an upper-middle-income emerging economy with a population of 56 million and a gross domestic product (GDP) per capita of US$5,274 in 2016 (World Bank 2016). As Africa's second largest economy (after Nigeria) and as a BRICS member, South Africa is seen by many as its region's leader. This has also been the case in international taxation, where South Africa is an active part of the OECD's work on BEPS.

In many ways, the South African macroeconomic statistics exemplify the common developing-country situation. Firstly, as with most developing countries,[13] South Africa is fiscally constrained. Tax revenue was 26 per cent of GDP in 2015–16, which is less than the OECD average of 34 per cent.[14] Historically, a substantial portion of tax revenue in developing countries has been collected from corporations, particularly large corporations.[15] This is also the case in South Africa where the corporate tax constitutes 19 per cent of total tax receipts—twice the developed country average (but on par with the developing country average).[16] Foreign-owned corporations constitute a large and growing share of the total corporate sector in developing countries (UNCTAD 2015). As shown in Figure 2, equity earnings of foreign-owned corporations operating in South Africa increased steadily up until 1982. International sanctions, internal turmoil, and global boycotts reversed this trend and the activity of foreign-owned corporations had plummeted to US$0.5 billion by the end of Apartheid in 1994. Since then an explosion of foreign activity has taken place in South Africa and in 2014 the equity earnings of foreign corporations reached US$8.6 billion. As a share of GDP, the earnings of foreign-owned corporations doubled in the last 25 years. How large this share would have been absent profit shifting is the question that this paper addresses.

This combination of fiscal constraints, high reliance on corporate tax receipts, and a growing exposure to foreign-owned firms makes the issue of profit shifting particularly relevant in South Africa. The corporate tax rate in South Africa has been 28 per cent since 2008, which is 4 percentage points above the world average and 13 percentage points above nearby tax haven

[13] This relates to the broad literature on fiscal/state capacity. See e.g. Besley and Persson (2013), Mascagni et al. (2014), and Kleven et al. (2016) for a discussion of tax collection constraints in developing countries.

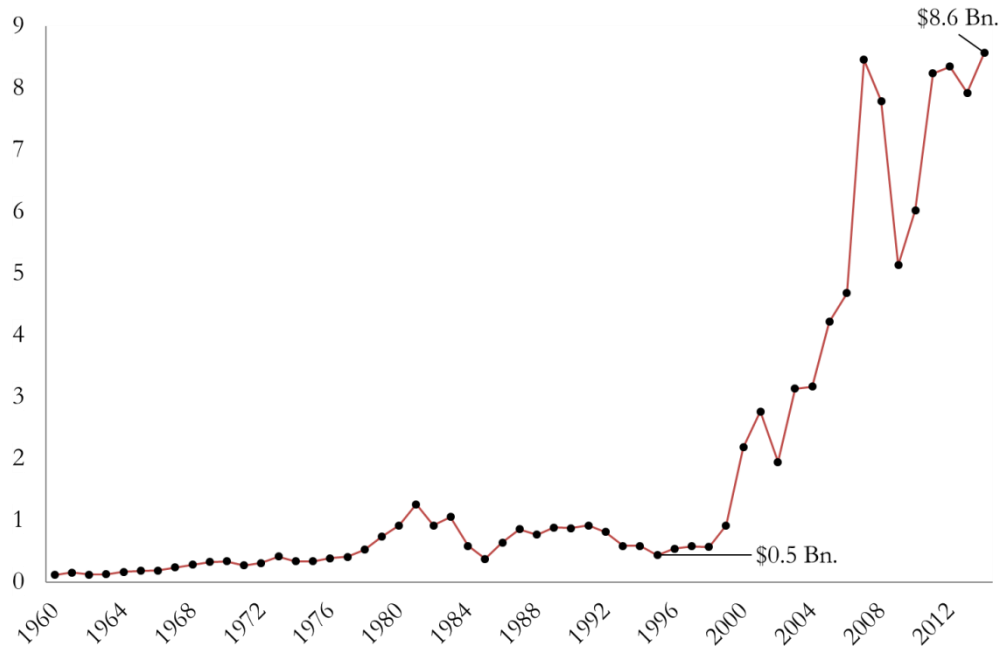
[14] See National Treasury (2016) and OECD (2016).

[15] Currently, corporate income tax constitutes 21 per cent of the total tax income in developing countries, compared to 11 per cent in developed countries (UNCTAD 2015).

[16] See UNCTAD (2015).

Mauritius—meaning that the incentive for firms to shift profits out of South Africa is certainly there.

Figure 2: Equity earnings of foreign-owned corporations in South Africa (US$ Bn.)



Note: The graph shows the dividend payments and retained earnings paid by foreign-owned corporations (where the share of directly owned equity entitles such corporations to 10 per cent or more of the voting power) operating in South Africa.

Source: Authors' calculations based on data from IMF (n.d.).

3 Data

We use tax administrative data from the South African Revenue Service.[17] Specifically, we have access to the universe of foreign-owned firms' tax returns in South Africa from 2010 to 2014. These data are collected by the South African Revenue Service annually. Tax returns include information on key financial items such as labour costs, fixed capital, turnover, and accounting profits. Unsurprisingly, tax returns also provide information on the actual taxable profits of firms, which is not covered in the frequently used ORBIS database and may be substantially different due to special tax credits and other book-tax differences. This is important, as *taxable* profits, not accounting profits, is what is relevant when studying profit shifting, which is why OECD (2015a) promotes the use of tax-administrative data. All reporting items used in this paper are compulsory. Firms not complying face potential audits and resulting fines. The level of detail and (full) coverage of these data are unlike any that have been used to study profit shifting in developing countries.

From May 2013 onwards, firms operating in South Africa have been required to indicate whether they are owned by a foreign parent (defined as an ownership stake above 70 per cent), and, if so, where this parent is located. Hence, this analysis focuses on foreign-owned firms operating in South Africa. The available data do not allow us to identify the location of foreign affiliates of

[17] For an in-depth description of the dataset, see Kreuser and Newman (2018).

firms operating in South Africa that are not the immediate parent.[18] We are thus only able to estimate profit shifting facilitated through the immediate parent firm, and any profit shifting via sister firms and from a South African parent to a foreign subsidiary is disregarded. This implies that our estimate of profit shifting out of South Africa will be a lower bound, ceteris paribus. Even so, the parent firms have both theoretically and empirically been proven to be a key factor in the profit-shifting decisions of MNEs (see e.g. Dischinger et al. 2013). It is common in the empirical literature that only the tax incentives of shifting between parents and subsidiaries are taken into account (see e.g. UNCTAD 2015 or Dharmapala and Riedel 2013).

Table 1 shows descriptive statistics on the foreign-owned firms in South Africa in 2014. Even though there are only little more than 2,000 foreign-owned firms in South Africa compared to the 1.2 million corporations operating in South Africa, these foreign-owned companies are very large compared to the domestic companies. In fact, foreign-owned firms account for more than 30 per cent of total sales of all companies operating in South Africa.

For most of the analysis in the paper, we use a simple profit-shifting incentive measure that is whether the parent is located in a tax haven as defined by Hines (2010).[19] However, all results are replicated using the statutory corporate tax rate of the parent taken from the KPMG Corporate Tax Tables (KPMG n.d.). As seen in Table 1, roughly one-fifth of the foreign-owned firms are owned directly through a tax haven. Measured at the average, the foreign affiliates of parents located in tax havens have similar fixed assets, wage bills, and sales—but far lower taxable income.

We are unable to track ownership links back in time and thus make the implicit assumption that ownership structures did not change from 2010 to 2014. This measurement error implies that a firm that is owned through a tax haven in 2014, but was not in 2013, will be falsely identified as having a tax haven linkage in 2013. This implies that our ownership variable has a measurement error, which will create an attenuation bias that should lead us to underestimate profit shifting. However, the South African tax specialists we discussed this with have the impression that firm ownership is constant over time; implying that this attenuation bias should be moderate.

[18] Discussion with tax advisers does suggest that some companies may fill this information in if at least a 50 per cent ownership stake is met.

[19] Following Hines (2010): Andorra, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain (The Kingdom of), Barbados, Belize, Bermuda, Cayman Islands, Hong Kong, Cook Islands, Costa Rica, Cyprus, Dominica, Grenada, Guernsey, Ireland, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, Luxembourg, Maldives, Malta, Marshall Islands, Mauritius, Micronesia, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, Samoa, San Marino, Seychelles, Singapore, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Switzerland, Tonga, Turks and Caicos Islands, and Virgin Islands (British)

Table 1: Summary statistics on foreign-owned firms in South Africa (2014)

Firms owned by parent in a tax haven						*Firms owned by a foreign parent not in a tax haven*					
	Obs	Mean	Std. Dev.	Min	Max		Obs	Mean	Std. Dev.	Min	Max
Absolute values (Million Rand)						*Absolute values (Million Rand)*					
Taxable profits	375	9.0	59.4	-387.0	592.0	Taxable profits	1,744	53.7	614.0	-2,800.0	21,700.0
Sales	373	290.0	699.0	0.0	5,910.0	Sales	1,717	363.0	808.0	0.0	6,720.0
Fixed capital	371	67.9	219.0	0.0	2,380.0	Fixed capital	1,720	52.9	212.0	0.0	2,390.0
Labour costs	375	51.5	149.0	0.0	1,490.0	Labour costs	1,744	66.4	327.0	0.0	11,400.0
Log values						*Log values*					
Taxable profits	234	15.6	2.1	3.5	20.2	Taxable profits	1,225	16.2	1.9	5.9	23.8
Fixed capital	365	16.2	1.9	10.2	21.1	Fixed capital	1,726	16.4	1.7	10.2	21.0
Labour costs	332	15.7	2.6	8.4	21.9	Labour costs	1,581	15.4	2.4	8.3	22.2
Profitability measures						*Profitability measures*					
Profits/Sales	303	0.00	0.30	-2.17	0.73	Profits/Sales	1,507	0.01	0.31	-4.28	0.82
Profits/Fixed assets	329	3.13	26.08	-139.57	189.23	Profits/Fixed assets	1,558	6.94	33.28	-174.80	493.30
Profits/Wage bill	364	-0.24	7.55	-82.05	41.89	Profits/Wage bill	1,715	0.39	5.60	-63.44	42.19
Misc.						*Misc.*					
Parent statutory tax rate	421	0.13	0.10	0.00	0.35	Parent statutory tax rate	1,962	0.31	0.07	0.10	0.55

Source: Authors' calculations based on data from Hines (2010), SARS (n.d.), and KPMG (n.d.).

4 Theoretical motivation of why size may matter

In this section, we motivate why firm size may impact profit shifting. We show how the existence of fixed costs in tax planning will imply that larger firms shift a larger share of their profits to tax havens. As we will see, the later empirical findings support this theory.

Imagine a multinational firm with a subsidiary in a high tax country with tax rate t and a parent in a tax haven with no corporate tax. Let π be the 'true profits' of the subsidiary and S denote the amount shifted to the tax haven. Then, each dollar of profits the subsidiary manages to artificially shift to its parent will yield a tax saving of t up until the point where there are no profits left in the subsidiary ($S = \pi$). Assuming that the firm seeks to maximize global profits and there are no costs involved, the subsidiary would shift all of its income to the parent in the tax haven ($S = \pi$) and obtain a tax saving of $t \cdot \pi$. However, there are costs involved with shifting profits, such as soliciting legal advice,[20] damaged public relations,[21] and potential efficiency loses.[22] If we assume that the multinational firm aims at maximizing global after-tax profits, the firm should shift income to the tax haven up until the point where the marginal costs of shifting equals the marginal tax saving. The profit shifting of each firm and its relation to firm size thus depends crucially on functional form of the cost function.

There is no rigorous analysis nor understanding of the shape of the cost function firms face when artificially shifting income. Huizinga and Laeven (2008) argue that the marginal costs of shifting will be proportional to the *share* of true income shifted (S/π). In this case the share of profits shifted to tax havens will not be impacted by the size of the firm.[23] Contrary to this, Davies et al (2018) and Johannesen et al. (2017) argue that there may be fixed costs connected to profit shifting. Intuitively, it seems realistic that there would be fixed costs of hiring a team of tax specialists with the intent to e.g. strategically manipulate transfer prices[24] or create artificial royalty income flows[25] with the intent to shift profits. A small accounting literature does find descriptive evidence of a

[20] A company engaging in profit shifting is likely to pay for legal advice and face the probability of legal consequences (which may require legal defence costs). These legal costs are, to a large degree, country-specific; that is, tax authorities and governments are able to increase the legal costs of profit shifting by enacting effective anti-profit-shifting legislation and by distributing resources to enforce this legislation.

[21] Anecdotal interviews with managers indicate that these costs are significant enough for managers to include them in their decision making.[21]

[22] Nielsen et al. (2008) describe how transfer mispricing strategies imply that low-level managers within the MNEs lose the ability to evaluate the true cost and value of internal transactions. Huizinga et al. (2008) describe how using increased cash flows to subsidiaries may create moral hazard implications at the subsidiary level.

[23] Denote the cost function $C\left(\frac{S}{\pi}\right)$ then the optimal share of shifted profits will be independent of π. To see this, note that in an internal optimum the marginal costs should yield the marginal tax saving $C'\left(\frac{S}{\pi}\right) = t \Rightarrow C'^{-1}(t) = \frac{S}{\pi}$

[24] As documented e.g. by Clausing (2003), Cristea and Nguyen (2016), Davies et al. (2018), Hebous and Johannesen (2017) or Wier (2018).

[25] Most famously, the 'Double-Dutch-Irish' exemplifies this (see e.g. Ting 2014).

relationship between firm size and tax planning that supports the notion of fixed tax-planning costs.[26]

If we assume a fixed cost must be incurred in order to shift profits then the size of profits, the amount that can be shifted, will be a key determinant in the shifting strategies of firms. Say that at a fixed cost F a firm can shift a fixed share of profits φ to the parent to obtain total tax savings of $t \cdot S = t \cdot \pi \cdot \varphi$. The firm will only enter into this tax scheme if the tax savings are larger than the fixed cost ($t \cdot \pi \cdot \varphi > F$). In this case size matters: small firms (with small π) will not enter into the tax scheme as the absolute tax savings do not outweigh the costs, while large firms (with large π) will. This finding is, for most people, common sense, and it is often just assumed in the public debate that the most aggressive profit shifters are also the largest firms (Jones 2015a). Nevertheless, the impact of firm size on profit shifting has not been rigorously studied before. This simple example motivates an empirical strategy that allows larger firms to have larger responses to tax incentives. As we will see, larger firms do in fact shift a larger share of profits to tax havens, which is consistent with the existence of fixed costs in tax planning.

5 What the raw data tell us about size

We begin by exploring the data in a simple visual exercise. Taking the sample of foreign-owned corporations, we divide them into fifty groups based on wage bill. Within these size groups we then compare foreign firms owned by parents located in tax havens (haven-owned) to firms owned by foreign parents that are not located in a tax haven (non-haven-owned). Starting from the input side, Figure 3a shows how the average wage bill of haven-owned and non-haven-owned firms is nearly identical within these fifty size groups. This is not surprising as the deciles were constructed using wage bills. Noisier are the average fixed asset discrepancies in Figure 3b, with a slight tendency of haven-owned firms to have more fixed assets. Nonetheless, within deciles, fixed assets are fairly similar across haven-owned and non-haven-owned firms. If anything, the haven-owned firms have slightly higher economic activity, suggesting that these firms should also report higher profits.

Moving to the reported economic output of firms, Figure 3c averages turnover across wage bill deciles. This measure of activity is partly endogenous to profit shifting as firms shifting income out of South Africa could price exports going to affiliates in tax havens too low and/or ensure that sales by the South African affiliate to third parties are redirected through the tax haven. We do see there is a slight tendency of haven-owned firms to report lower sales (consistent with profit shifting). Nonetheless, haven-owned and non-haven-owned firms seem similar across size groups in terms of sales.

To summarize, we see similar wage bills, fixed assets, and turnover of haven-owned and non-haven-owned firms across size groups. It is hence striking to see the stark differences in taxable profits in Figure 3d. For example, among the largest 2 per cent of firms, the haven-owned firms had 6 per cent higher wage bills, 6 per cent higher turnover, and 22 per cent more fixed assets, **but** 72 per cent lower taxable profits. This implies that a haven-owned firm in the top two percentiles will be earning 740 million Rand (~US$70 million) less than a non-haven-owned firm in the same top two percentiles. In Figure 4 the absolute differences in taxable profits are shown within each

[26] Most notably, Mills at al. (1998) use a confidential survey of 365 US firms (conducted by Slemrod and Blumenthal 1996) and establish that costs of tax planning pr. tax benefit decrease by firm size. Similarly, Wilson (2009) finds, based on news articles, that the likelihood of aggressive tax planning increases by firm size.

size group. The immediate insight here (as in Figure 3d) is the sheer difference in magnitude across size groups—the gap among the largest 4 per cent of firms is orders of magnitude larger than what is seen in any of the other percentiles. As also shown in Figure 4, this gap remains after removing industry-specific effects.

Figure 3: Discrepancies between economic activity and profits across size groups

Figure 3a: Average wage bill by size and parent origin

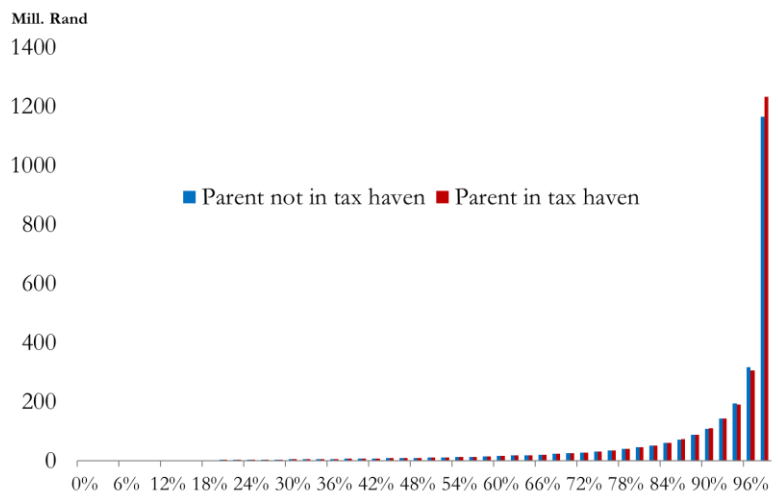


Figure 3b: Average fixed assets by size and parent origin

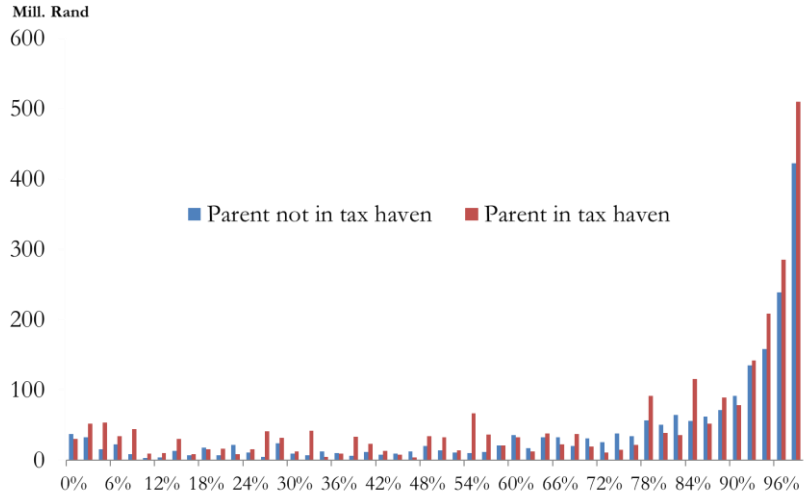


Figure 3c: Average turnover by size and parent origin

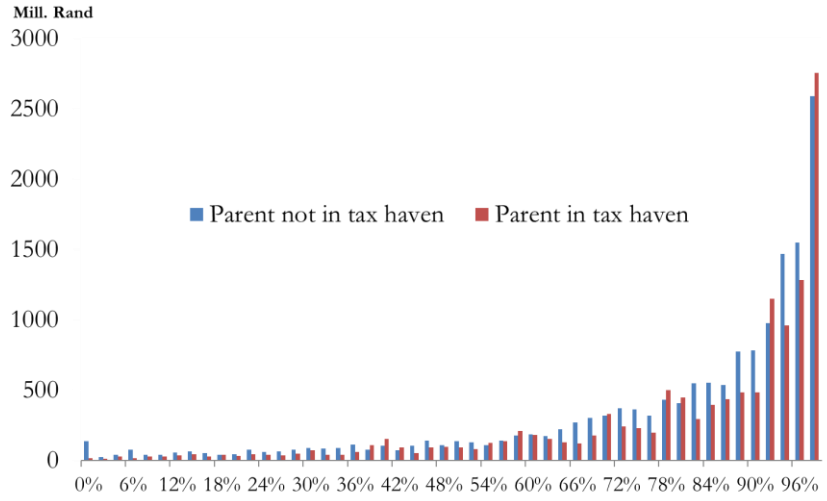
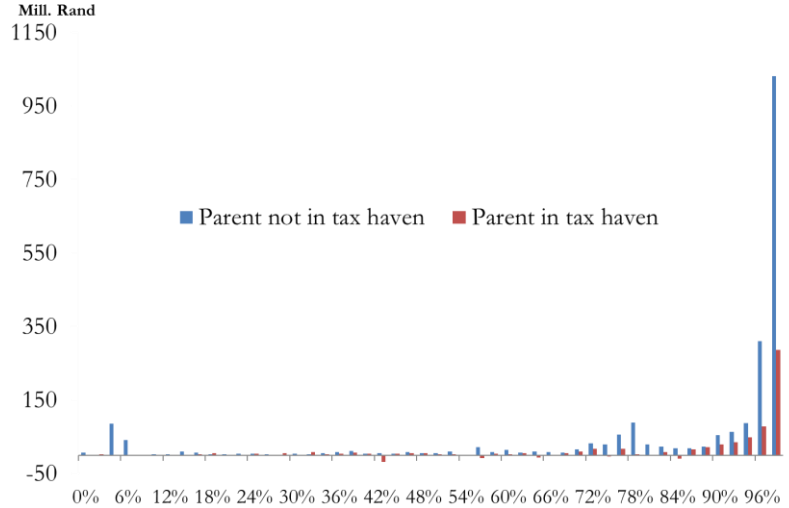


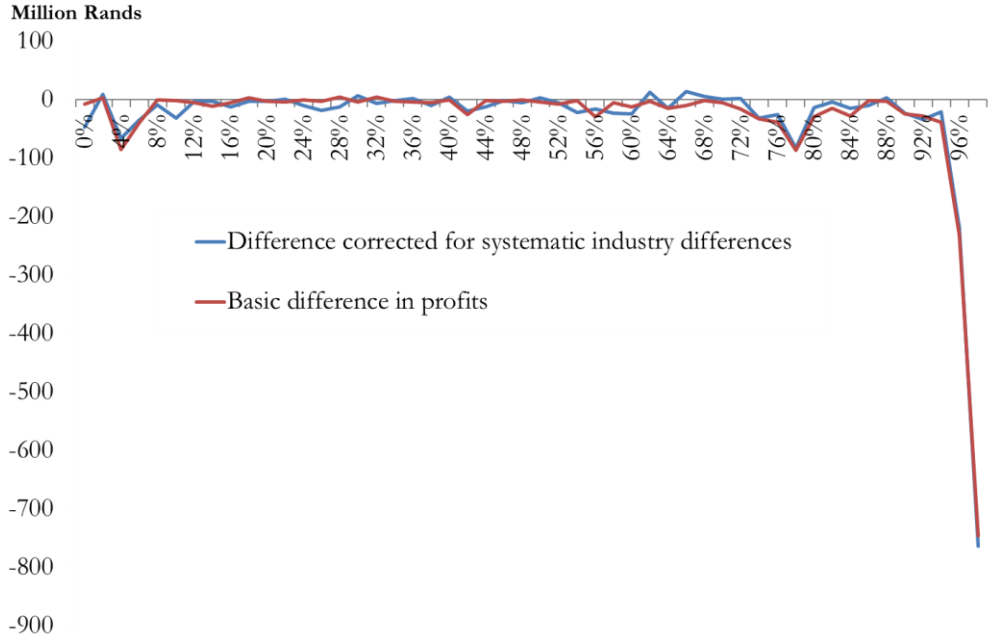
Figure 3d: Average taxable profits by size and parent origin



Note: This figure shows descriptive statistics on foreign-owned firms operating in Sout Africa. Deciles are constructed based on wage bills such that 0–2% includes the smallest 2 per cent of firms while deciles 98–100% include the largest 2 per cent of firms. Within these deciles, firms are divided according to the location of the parent firm.

Source: Authors' calculations based on data from SARS (n.d.).

Figure 4: Average difference in reported income of haven vs. non-haven-owned firms



Note: This graphs shows the contribution of each decile to the overall average earnings discrepancy between haven-owned and non-haven-owned firms.

Source: Authors' calculations based on data from SARS (n.d.).

6 Disentangling the macro perspective

Past macro studies of profit shifting have documented how the profitability of foreign-owned firms across countries is impacted by the tax incentive to shift profits (see e.g. Hines and Rice 1994; Zucman 2014; UNCTAD 2015; Clausing 2016; Tørsløv et al. 2018). These studies can ultimately only estimate the aggregate amount of profits shifted but are unable to determine *which* foreign-owned firms are driving the macro estimates. The South African micro data allow us to open the black box of macro studies and disentangle which firms are driving these estimates. We do this by adding up the micro data, replicating past macro findings, and then decomposing the macro estimate using the micro data.

In Figure 5 we add up the South African tax returns of foreign-owned subsidiaries to calculate the macro profitability across firm ownership. In Figure 5a we see how profits per wage paid are 85 per cent in foreign-owned firms if the parent is not located in a tax haven. Contrary to this, Figure 5a also shows that the profits per wage paid are only 19 per cent in firms owned by a parent located in a tax haven. That is, subsidiaries of tax haven-owned firms are roughly 80 per cent less profitable than their non-haven-owned counterparts. This finding is corroborated when looking at taxable income per fixed assets in Figure 5b. Taken at face value, this suggests that 80 per cent of the

income of haven-owned subsidiaries is lost to tax havens. This kind of macro statistic underlies past macro studies on profit shifting and the estimate is comparable to previous studies.[27]

Using the micro data, we can now calculate the contribution of each firm to this macro-profitability gap:

$$\Delta\pi_i = 85\% \cdot L_i - \pi_i$$

Where $\Delta\pi_i$ is the contribution of each firm to the macro-profitability gap, 85 per cent is the overall ratio of profits to wages paid in non-haven-owned firms, L_i is the wage bill, and π_i is the reported taxable income. This exercise allows us to understand which firms drive previous macro estimates of profit shifting. Secondly, if one believes the macro estimate, it gives us a heroic estimate of the profits shifted at the firm level.[28]

In Figures 6a and 6b we rank the haven-owned firms according to their contribution to the macro-profitability gap and plot the cumulative contribution as a share of the total profitability-gap. There are several important insights from this graph. Firstly, underperformance is widespread among haven-owned firms: more than 80 per cent of haven-owned firms contribute positively to the profitability gap between haven-owned and non-haven-owned firms. This implies that more than 80 per cent of haven-owned firms are less profitable than the average non-haven-owned firm. Secondly, the bulk of the aggregate profitability gap is driven by very few firms: ten firms drive 50 per cent of the aggregate profitability gap.

[27] UNCTAD (2015) use foreign direct investment (FDI) flow and stock statistics to estimate the impact of haven ownership on the return on assets. In developing countries they find that if the FDI stock was 100 per cent owned through tax havens, return on FDI assets would fall by 11–16 percentage points. In South Africa, the return on assets in haven-owned firms is 3 per cent. According to UNCTAD (2015) the return on assets of these affiliates would have been 14-19% (3%+11–16%) => 70–80% of haven-owned firms' tax base shifted out of South Africa.

[28] Interpreting the firm-specific contributions to the profitability gap as profit shifting will of course be bound with uncertainty, but it does have some theoretical backing. We are simply using the standard theoretical insight that the wage share should be constant in an economy with perfect competition and a Cobb–Douglass production function: If production is given by $A_i K_i^a L_i^{1-a}$ and capital inputs are paid their marginal value, then the wage share $\frac{w \cdot L}{K \cdot r} = 1-a$ will only depend on the elasticity of production with respect to labour and not be impacted by firm-specific technology A_i , capital K_i, or labour inputs L_i. It should be noted that, as in many countries, the notion of perfect competition in South Africa is not entirely true, as many industries are highly concentrated.

Figure 5: Profitability of foreign-owned subsidiaries in South Africa

Figure 5a: Taxable income (% of wage bill)

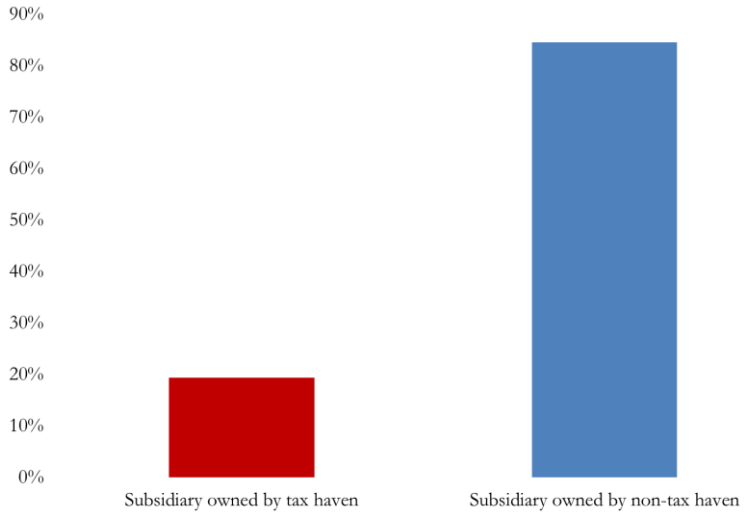
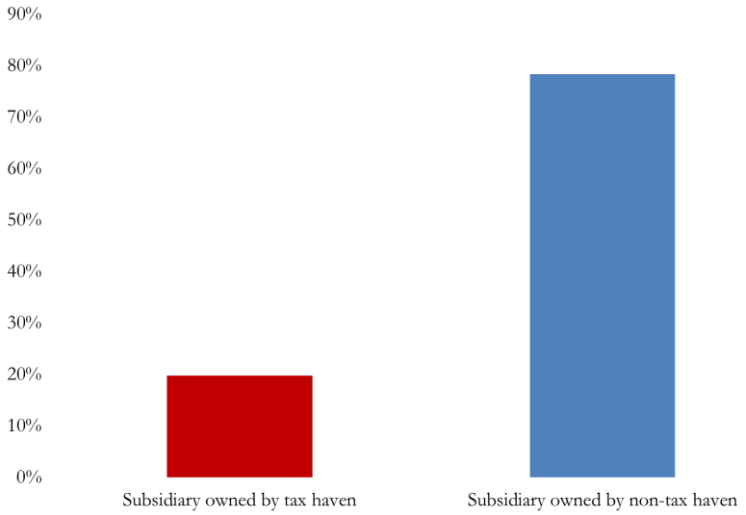


Figure 5b: Taxable income (% of fixed assets)



Note: The figure shows the aggregate profitability gap between haven-owned and non-haven-owned subsidiaries. Profitability is calculated by taking the sum of taxable income and dividing by the sum of wages paid/fixed assets. Tax havens are defined using the list put forward by Hines (2010).

Source: Authors' calculations based on data from SARS (n.d.).

Figure 6: Disentangling the macro-profitability gap

Figure 6a: Cumulative share of estimated tax loss across firms

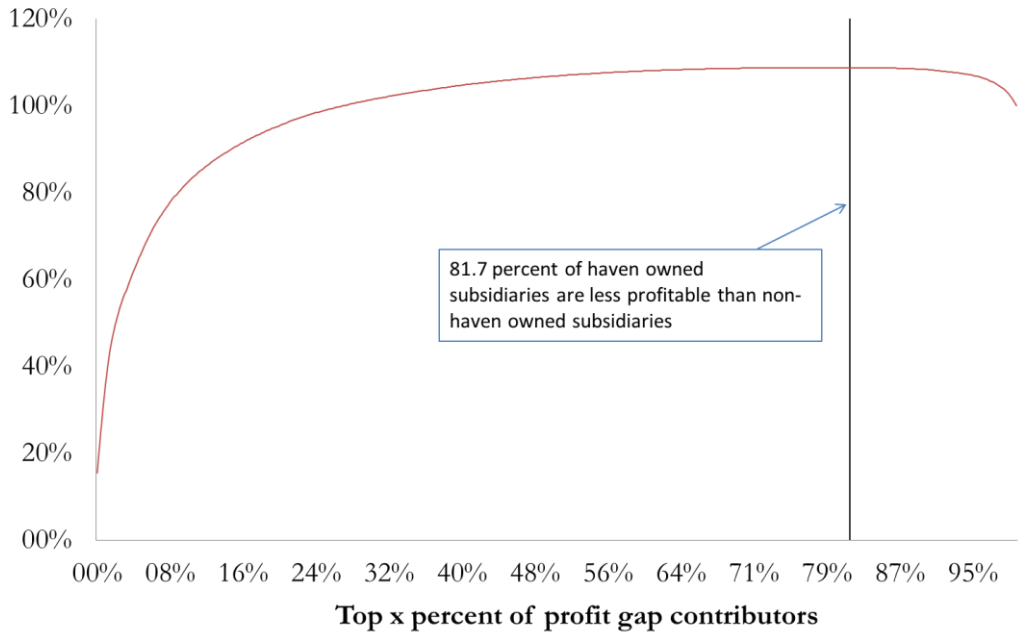
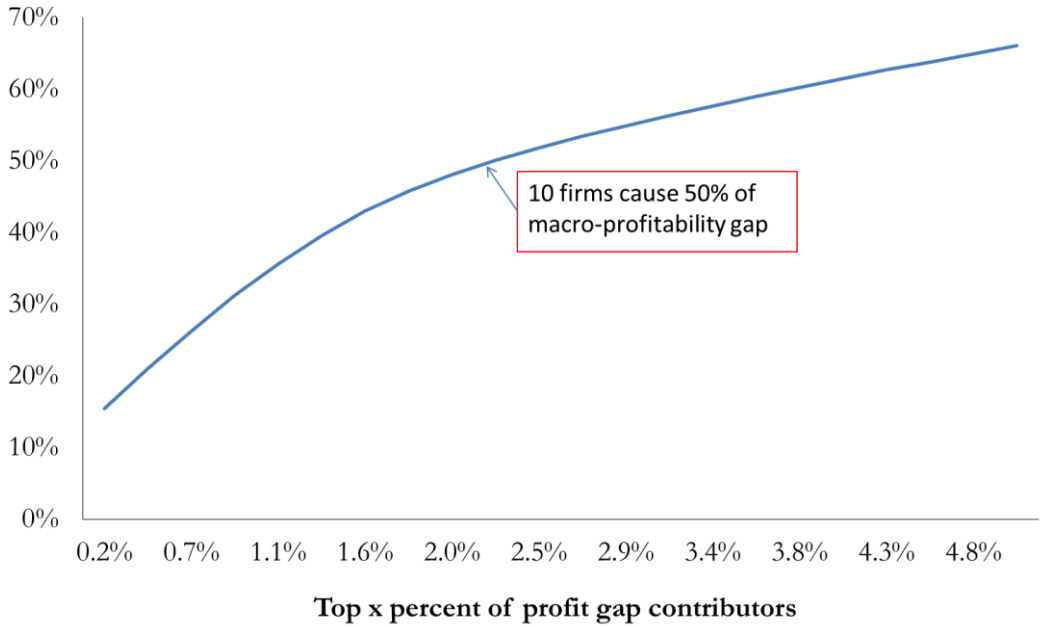


Figure 6b: Cumulative share of estimated tax loss across firms (top 5% of contributors)



Note: This figure shows the contribution of haven-owned firms to the overall (macro) profitability gap between haven-owned and non-haven-owned firms. The haven-owned firms are ranked according to their absolute contribution measured as $\Delta\pi_i = 85\% \cdot L_i - \pi_i$, where π_i denotes taxable income, L_i the wage bill, and 85 per cent is the average profitability of non-haven-owned foreign firms.

Source: Authors' calculations based on data from SARS (n.d.).

Apart from a sizable wage bill, there are clear characteristics attached to the firms driving the gap. The first is industry; 28 per cent of the macro-profitability gap is driven by companies operating in the resource extractive industry, despite these firms only constituting 2 per cent of foreign-owned firms. This is alarming given the large share of total economic activity resource extraction constitutes in developing countries.[29] Next to resource extraction is the financial industry, accounting for 19 per cent of the total profit gap.

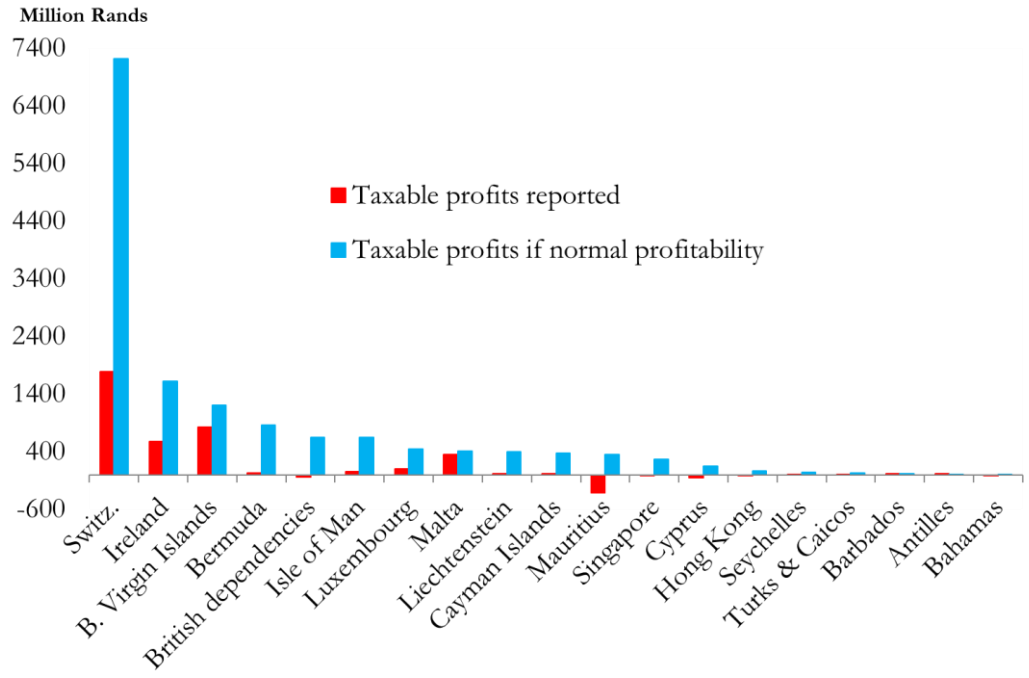
A final way to examine the profitability gap is by parent location. In Figure 7 we divide firms based on parent location and compare the reported taxable income (the red bars) to the income they would have reported if they had the same profitability as the non-haven-owned firms (85 per cent of the wage bill—the blue bars). The aggregate gap between the red and blue bars adds up to the total profit gap between haven and non-haven-owned firms. From Figure 7 it is clear that, without exception, all tax haven owners are underperforming compared to the non-haven owners, on average. It is striking that there are many haven owners that report near zero or negative profits in South Africa despite having large wage bills. These havens include Bermuda, the British Crown Dependencies, Liechtenstein, Cayman Islands, Mauritius, Singapore, and Cyprus. However, what is immediately clear is that, in terms of magnitude, Switzerland is the main contributor—50 per cent of the profit gap between haven-owned and non-haven-owned firms is due to Swiss-owned firms. This may not come as a surprise in the light of recent anecdotal evidence of the active role of Swiss subsidiaries in Africa.[30]

Repeating this exercise using profitability measured as taxable profits over fixed assets does not change these findings. There are, however, huge caveats to this simple analysis of firm profitability. First, we would want to allow industry-specific deviations in profitability. Second, production inputs should be taken into account simultaneously. Finally, the return on the production inputs (determined by production elasticities and bargaining power) of large and small firms should be allowed to differ. The next natural step is thus to move to a regression analysis.

[29] Total natural resources rents (percentage of GDP) are three times the developed country average in South Africa and other middle-income countries, and twelve times as high in low-income countries (World Bank 2013).

[30] See e.g. Jones (2015b) or ActionAid (2012, 2015).

Figure 7: Predicted vs. actual profits in haven-owned firms



Note: This figure shows the discrepancy in reported taxable income and the predicted income across tax haven-owned firms. Normal profitability is defined as having a taxable income of 85% of the wage bill paid (which is the average among non-haven-owned firms).

Source: Authors' calculations based on data from SARS (n.d.).

7 What regressions hide

We employ the standard identification strategy introduced by Hines and Rice (1994) and since exploited in more than 30 academic papers,[31] which is an ordinary least squares (OLS) regression of the form:

$$\log(\pi_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \text{Parent in haven}_i + \alpha_{nt} + \epsilon_i \quad (1)$$

Where the unit of observation is at the firm-year level, *i* denotes the firm, and *t* denotes the period. π_{it} is the taxable income of the firm, K_i denotes the fixed assets, and a_{nt} are industry-year fixed effects. *Parent in haven*$_i$ is a dummy variable taking the value one if the parent is located in a tax haven as defined by Hines (2010).[32] Standard errors are clustered at the industry level.

[31] See de Mooiji and Ederveen (2008), Dharmapala (2014), or Heckemeyer and Overesch (2013) for a review of this literature.

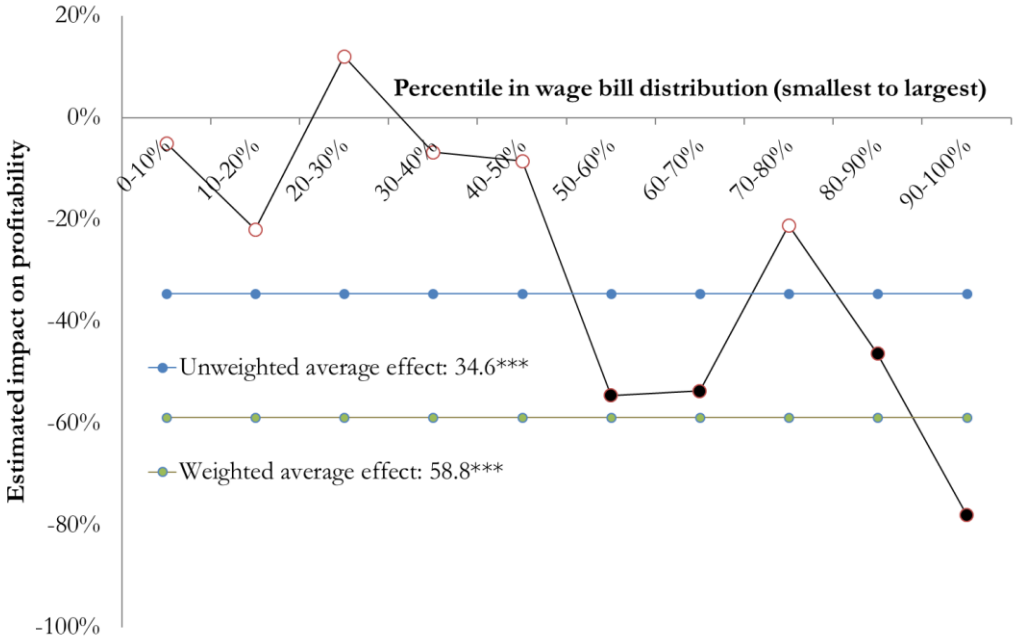
[32] Following Hines (2010): Andorra, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, (The Kingdom of), Barbados, Belize, Bermuda, Cayman Islands, Hong Kong, Cook Islands, Costa Rica, Cyprus, Dominica, Grenada, Guernsey, Ireland, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, Luxembourg, Maldives, Malta, Marshall Islands, Mauritius, Micronesia, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, Samoa, San Marino, Seychelles, Singapore, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Switzerland, Tonga, Turks and Caicos Islands, and Virgin Islands (British)

The identifying assumption is that if there is no profit shifting, and conditional on production inputs, the location of the parent will have no (systematic) impact on profitability and β_3 should hence be zero. However, if $\beta_3<0$ this means that firms owned by a tax haven are systematically underperforming and indicates that firms with a parent in a tax haven are shifting profits out of South Africa. One crucial caveat is that we cannot observe foreign affiliates in tax havens other than the parent firm. If firms without a parent in a tax haven are shifting profits to sister companies in tax havens (i.e. non-parent affiliates), this lowers the control group profitability and creates a downward bias in our estimate. Our results should hence be seen as a lower bound estimate of profit shifting to parents in tax havens.

Across the full sample we find that the haven dummy coefficient is -34.6 per cent and statistically significant at the 1 per cent level. This implies the *average* firm with a parent in a tax haven will be associated with approximately -34.6 per cent lower taxable profits. However, this average across firms conceals large and systematic deviations across firm size. We extend the analysis by dividing the sample into ten groups according to wage bills and run the regression within these groups. In Figure 8 the coefficient of each of these ten regressions is plotted with a filled marker indicating significance at the 10 per cent level. Notably, there is no statistically, nor economically significant, association between haven ownership and profitability in the bottom 50 per cent (deciles one to five). On the contrary, the estimated haven coefficient is below -40 per cent and statistically significant in four out of five of the top deciles. Among the 10 per cent largest firms, a haven affiliation is associated with nearly 80 per cent lower taxable income.

In terms of the actual tax base, the 10 per cent largest foreign subsidiaries (measured according to wage bill) earn 80 per cent of the income accruing to foreign-owned companies. The profit shifting of these firms is hence more informative about total profit shifting than the responses of all other firms combined. Subsequently, failing to account for the more aggressive profit shifting of larger firms will dramatically underestimate total profit shifting. More philosophically, the firm is to some extent an arbitrary level of observation and hence the *average* firm is a somewhat arbitrary statistic. If two firms merge, are they then half as relevant? Do we care as much about a one-man firm as we do about a firm employing 1,000 employees? As an alternative to the unweighted average, we re-estimate Equation 1 in a *weighted* regression using wage bill as the weight. The estimated coefficient is -58 per cent or almost twice the unweighted estimate.

Figure 8: Impact of having a parent in a tax haven across size deciles



Note: This figure shows the differential impact of having a parent in a tax haven. Size deciles are comstructed using wage bill; 0–10% being the smallest 10 per cent of firms and 90–100% being the largest 10 per cent. The OLS model $\log(\pi_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \text{Parent in haven}_i + \alpha_{nt} + \epsilon_i$ is estimated within deciles and β_3 plotted. An empty marker indicates statistical insignificance. The blue line shows the unweighted average estimate of β_3. The green line shows the wage bill weighted estimate of β_3 . Full regression results are available in the online appendix.

Source: Authors' calculations based on SARS (n.d.).

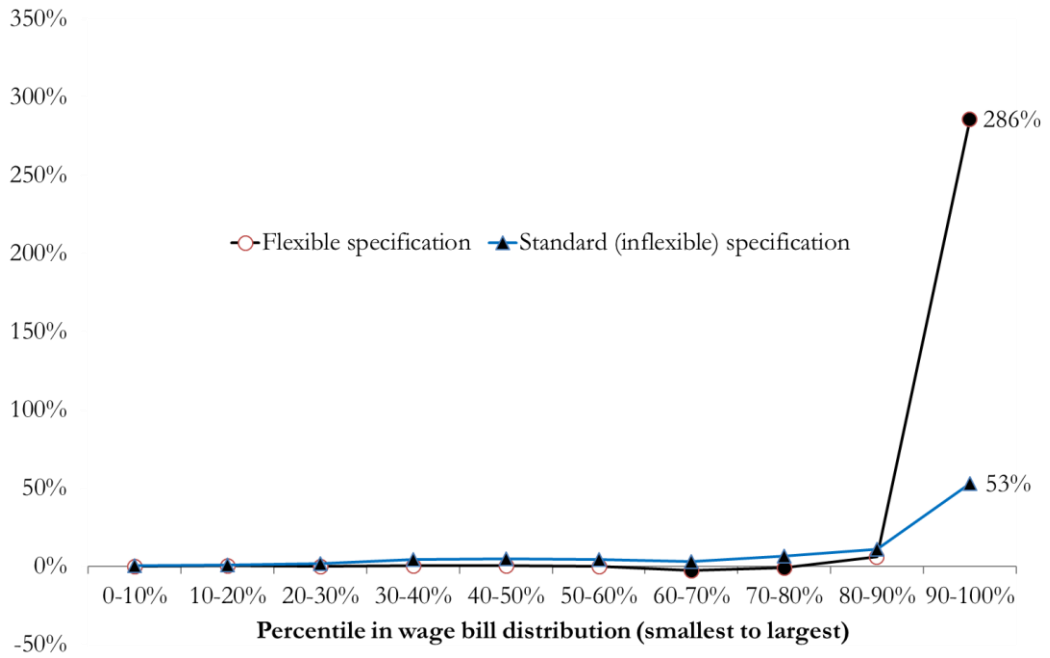
The size heterogeneities in profit-shifting responses are very impactful on the overall tax loss estimates. The estimated tax loss (in absolute values) is eight times higher where β_3=80% compared to β_3=33%. [33] When adding to this that 80 per cent of the current tax base of foreign-owned firms is reported in the top decile, the total loss estimate changes dramatically when allowing tax responses to differ across deciles.

In Figure 9 we plot the estimated cumulative tax loss as a share of the current tax payments of the haven-owned firms. The inflexible (standard specification) estimate is an aggregate tax loss of 53 per cent of the current tax base, while the flexible specification estimate is an aggregate tax loss of 286 per cent (i.e. the tax base of haven-owned firms would increase by 286 per cent absent profit shifting). That is, the dollar value of the estimated tax loss increases six-fold when properly accounting for firm size (286 per cent divided by 53 per cent). Notably, **98 per cent** of the tax loss is driven by the top decile.

[33] To see this, note that $\frac{\text{Tax loss}}{\text{Current tax revenue}} = \left(\frac{1}{1-\beta_3} - 1\right)$, which is 400 per cent in the case of β_3=80% and 50 per cent in the case of β_3=33%.

We perform a series of robustness checks. First, we define the deciles by turnover instead of wage bill, which does not impact the results. Second, using the re-weighting procedure by DiNardo et al. (1996) and Boserup et al. (2016), we match observations based on wage bills and then estimate the model on the matched sample. Again, this does not change the results. Third, instead of relying on a binary measure of whether the parent is in a tax haven, we use the statutory tax rate of the parent country. This also does not impact the results. Finally, as discussed in Johannesen et al. (2017), a logarithmic specification has the limitation of censoring zero or negative values of taxable income. Hence, we re-estimate the model using a hyperbolic sine transformation, which increases the response to tax incentives at all deciles but does not change the qualitative results.

Figure 9: Estimated tax loss (% of current tax payments in haven-owned firms)



Note: This figure shows the implications for revenue loss estimate when allowing for differential effects across firm size. Size deciles are constructed using wage bills; 1 being the smallest 10 per cent of firms and 10 being the largest 10 per cent. In the flexible specification, the OLS model $\log(\pi_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \text{Parent in haven}_i + \alpha_{nt} + \epsilon_i$ is estimated within deciles and the tax loss of each decile is computed using the formula: current tax base of haven-owned firms$\cdot \left(\frac{1}{1-\beta_3} - 1\right)$. In the inflexible specification, β_3 is estimated across the entire sample and not allowed to vary. Full regression results are available in the online appendix.

Source: Authors' calculations based on data from SARS (n.d.).

8 Beyond South Africa: revisiting the OECD BEPS estimate

South Africa might be a special case. To test the external validity of our results, it is necessary to test how heterogeneity in profit shifting across firm sizes may look in other settings.

In the G20-mandated BEPS report, the OECD engages in an ambitious attempt to estimate the global tax loss caused by profit shifting. The underlying methodology is to relate the profitability of MNE entities to a profit-shifting incentive. Concretely, the estimated model takes the form:

$$\frac{\text{Profits}_i}{\text{Total Assets}_i} = \alpha \mathbf{X} + \beta_1 \left(\tau_i - \frac{\Sigma \tau_k}{N}\right) + \epsilon_i \qquad (2)$$

Where $\boldsymbol{X}$ is a vector of country, industry, and firm controls; τ_i is the corporate tax rate of the entity in scope; and $\frac{\Sigma\tau_k}{N}$ is the average tax rate facing the MNE group as a whole. β_1 is the coefficient of interest, which shows the impact of being a relatively highly taxed subsidiary in the MNE group. If profit shifting occurs $\beta_1 < 0$ as we anticipate high tax subsidiaries $\tau_i > \frac{\Sigma\tau_k}{N}$ to shift profits to low-tax affiliates.

As an illustration of the impact of size outside of South Africa, we revisit the OECD BEPS estimate. Concretely, we estimate Equation 2 on the global sample of MNE subsidiaries in ORBIS in 2010. Following the approach set out in this paper, we then re-estimate the model within size groups. That is, we divide the sample into twenty size bins based on total assets and estimate the model within each bin. In Figure 10a the estimated coefficients are plotted with a filled marker indicating significance. The unweighted average effect of the tax differential is -7.1 per cent, which implies that a one percentage point increase in the tax differential will imply a 7.1 percentage point drop in profits per assets. However, this unweighted average effect conceals large differences across firm size. In the bottom 35 per cent of MNE subsidiaries there is essentially no estimated impact of the tax differential, and it is these subsidiaries that drag down the overall unweighted effect. ORBIS coverage is particularly poor in small companies, which may explain the difference to the South African case, in which we saw a zero response to tax haven affiliation in the bottom 50 per cent of firms. The estimated impact in the top 5 per cent largest subsidiaries is -10.9 per cent. All in all, the South African phenomenon of stronger profit shifting responses in larger firms seems to go beyond South Africa.

As the attentive reader will notice, the slope of the size curve in Figure 10a is flatter than what we saw in the South African data in Figure 8. However, ORBIS accounts for less than 17 per cent of multinationals' global profits (Tørsløv et al. 2018), and there is good reason to believe coverage is particularly poor in the smallest of firms. If ORBIS data are left-censored the size curve might very well be the same globally as it is in South Afrcia.[34] More importantly, the fact that ORBIS coverage is not universal (or representative), combined with systematic differences in firm responses across size, warrants caution when interpreting the estimated *average* elasticities estimated using ORBIS.[35]

[34] We can add to this that some of the world's very largest subsidiaries in tax havens (and presumably most actively profit shifting) are systematically absent in ORBIS, which again flattens the size curve. See Tørsløv et al. (2018).

[35] Other concerns about using the ORBIS database are discussed in the Introduction, OECD (2015a: 32–37), and Tørsløv et al. (2018).

Figure 10: Revisiting the OECD profit shifting estimate

Figure 10a: Heterogeneity in OECD estimate across entity size

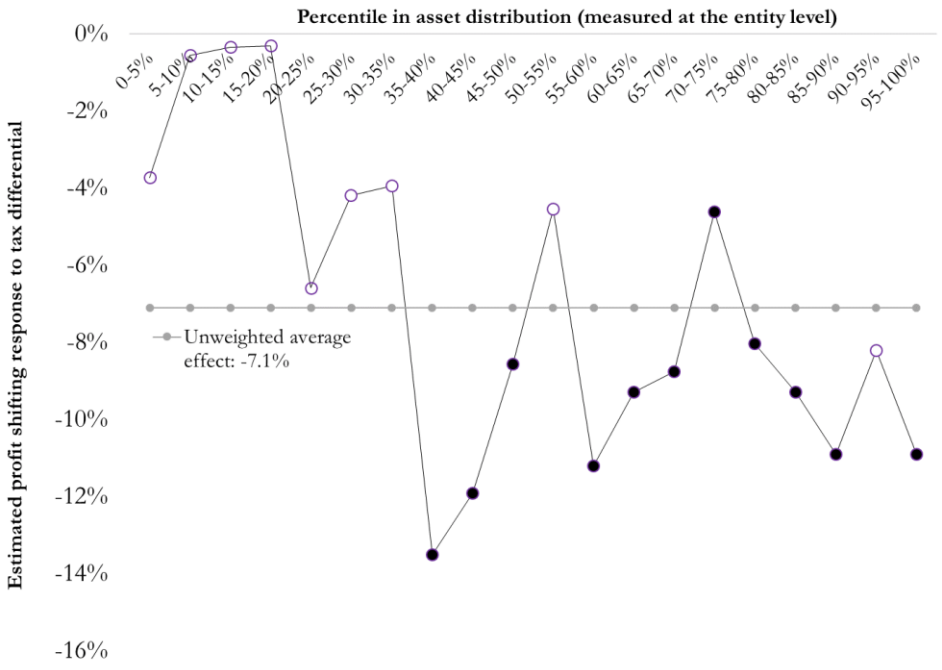
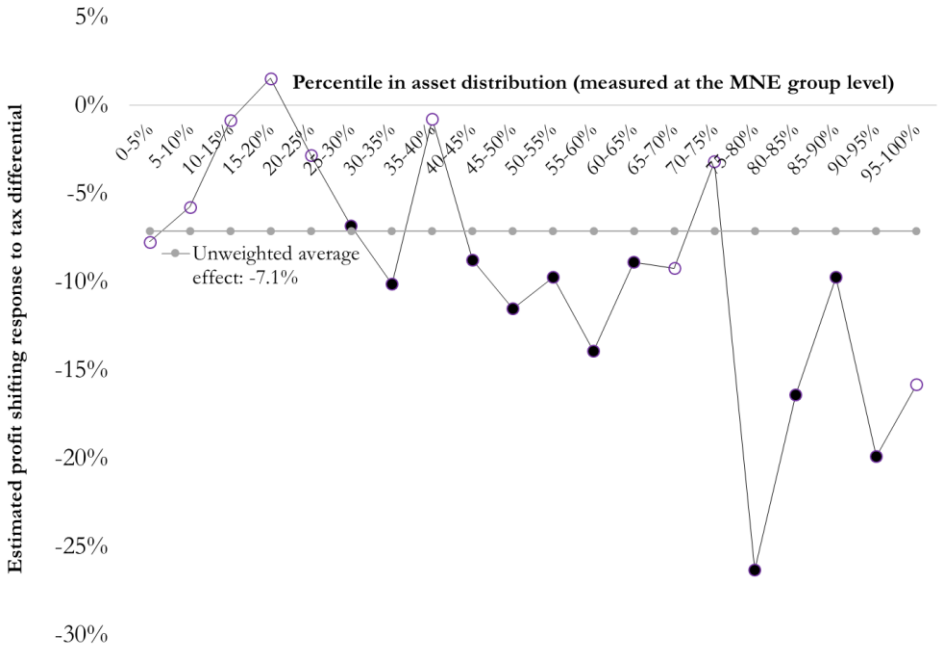


Figure 10b: Heterogeneity in OECD estimate across MNE group size



Note: This figure revisits the OECD BEPS report estimate of profit shifting. Each marker indicates the estimate of β_1 obtained from fitting the OLS model $\frac{\text{Profits}_i}{\text{Total Assets}_i} = \alpha \mathbf{X} + \beta_1 \left(\tau_i - \frac{\Sigma \tau_k}{N}\right) + \epsilon_i$. Size deciles are constructed using total assets and the model is then estimated within size groups. A filled marker indicates statistical significance. The grey line shows the unweighted average estimate of β_1. The red line shows the wage bill weighted estimate of β_1. Full regression results are available in the online appendix.

Source: Authors' calculations based on data from SARS (n.d.).

In the simple model presented in this paper, the size of the subsidiary was the only determinant of profit shifting. However, in reality, we might suspect that the size of the multinational group as a whole is a more relevant driver of profit shifting. If a multinational group is very large, the parent can then put in costly efforts to shift intellectual property to tax havens and later reap the tax benefit of having all subsidiaries shift income to the tax haven.[36] The decision of the parent in this case depends on the overall size of the group, not the size of the entity. Contrary to the South African data, ORBIS has (some) information on the entire multinational group, which allows us to rank the firms according to the total assets in the entire group. In Figure 10b we compare the estimated profit-shifting response across group size deciles. We indeed find that the size curve is much steeper, which indicates that group size is a more potent driver of profit shifting than entity size. In the largest 20 per cent of multinational groups (measured according to total assets), the estimated profit shifting response ranges from -9.7 per cent to -26.3 per cent, which is between 36 per cent and 370 per cent larger than the unweighted mean (of -7.1 per cent).

9 Conclusion and questions for future research

In this paper, we examine how estimated profit-shifting responses differ across firm size. Remarkably, we show how a standard estimation procedure will lead to zero or marginal effects among the bottom 50 per cent of firms. However, the estimated responses increase with size and are substantial at the top of the size distribution. As the bulk of the corporate tax base is at the very top, this implies that profit-shifting responses estimated at the mean are substantially smaller than the actual aggregate response. In the South African case, the estimated tax loss increases by 600 per cent when properly accounting for firm size, and as much as 98 per cent of this tax loss is caused by firms operating in the top decile. This finding is not unique to South Africa—we revisit the OECD official estimate of profit shifting and again find that profit-shifting responses are largest in the largest firms, which is why an unweighted average effect will underestimate tax losses. We show how these findings can fully explain the observed gap between micro and macro estimates of profit shifting which have puzzled both academics and policy makers (see e.g. Beer et al. 2018).

Inequality in profit shifting as documented in this paper shows how profit shifting creates competitive distortions by granting an uneven tax benefit to the largest of firms. Additionally, the fact that the largest firms benefit disproportionally more may simply seem unfair.

A number of questions are left unanswered in this study. First, it remains to be tested whether these findings are robust using a more causal identification strategy, e.g. in an event study design (such as Dharmapala and Riedel 2013; Johannesen and Larsen 2016; Johannesen et al. 2017). The short time span of the subsidiary panel in South Africa unfortunately did not allow any testing of this. Second, a question for further research is whether the inequality of profit shifting differs across countries. To test this rigorously, tax administrative data of other countries would need to be accessed, as low-coverage databases such as ORBIS will not include the full firm distribution. Third, the South African firm data do not allow us to study profit shifting to sister firms (foreign affiliates other than the parent) or from South African parents to foreign subsidiaries, and further studies of this are required to understand the full picture. Finally, a larger question for further research is what mechanisms drive the observed link between firm size and profit shifting.

[36] See e.g. Zucman (2014) for examples of this.

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